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Campbell

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[54] **RAMP-OPERATED MECHANICAL GATE SYSTEMS**

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[51] **Int. Cl.**[3] **E05F 13/00**

[52] **U.S. Cl.** **49/269;** 49/271; 49/274

[58] **Field of Search** 49/269, 273, 274, 272

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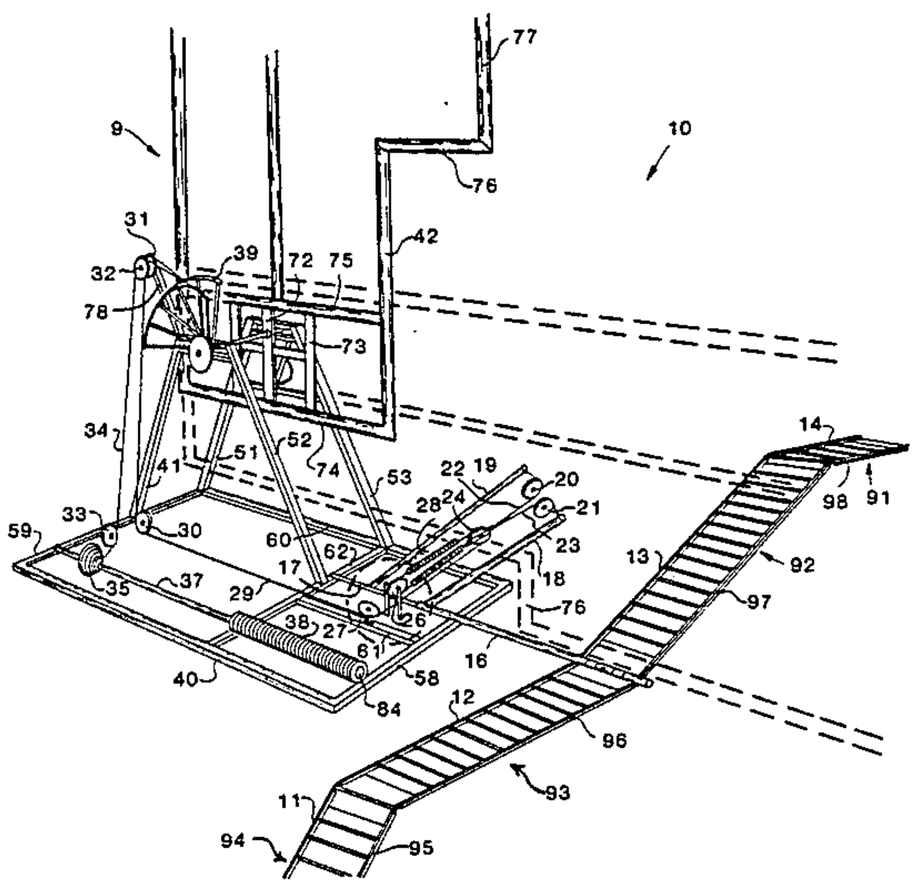
Primary Examiner—Philip C. Kannan
Attorney, Agent, or Firm—Leonard D. Schappert

[57] **ABSTRACT**

A ramp-operated mechanical gate system, including vertically-swinging gate, sliding gate and side-swinging gate embodiments which utilize collapsible ramps to supply energy to open a gate so that the gate is opened automatically when the collapsible ramp is depressed by an approaching vehicle and is closed automatically when the vehicle drives through the gate and the ramp is no longer depressed.

7 Claims, 20 Drawing Figures



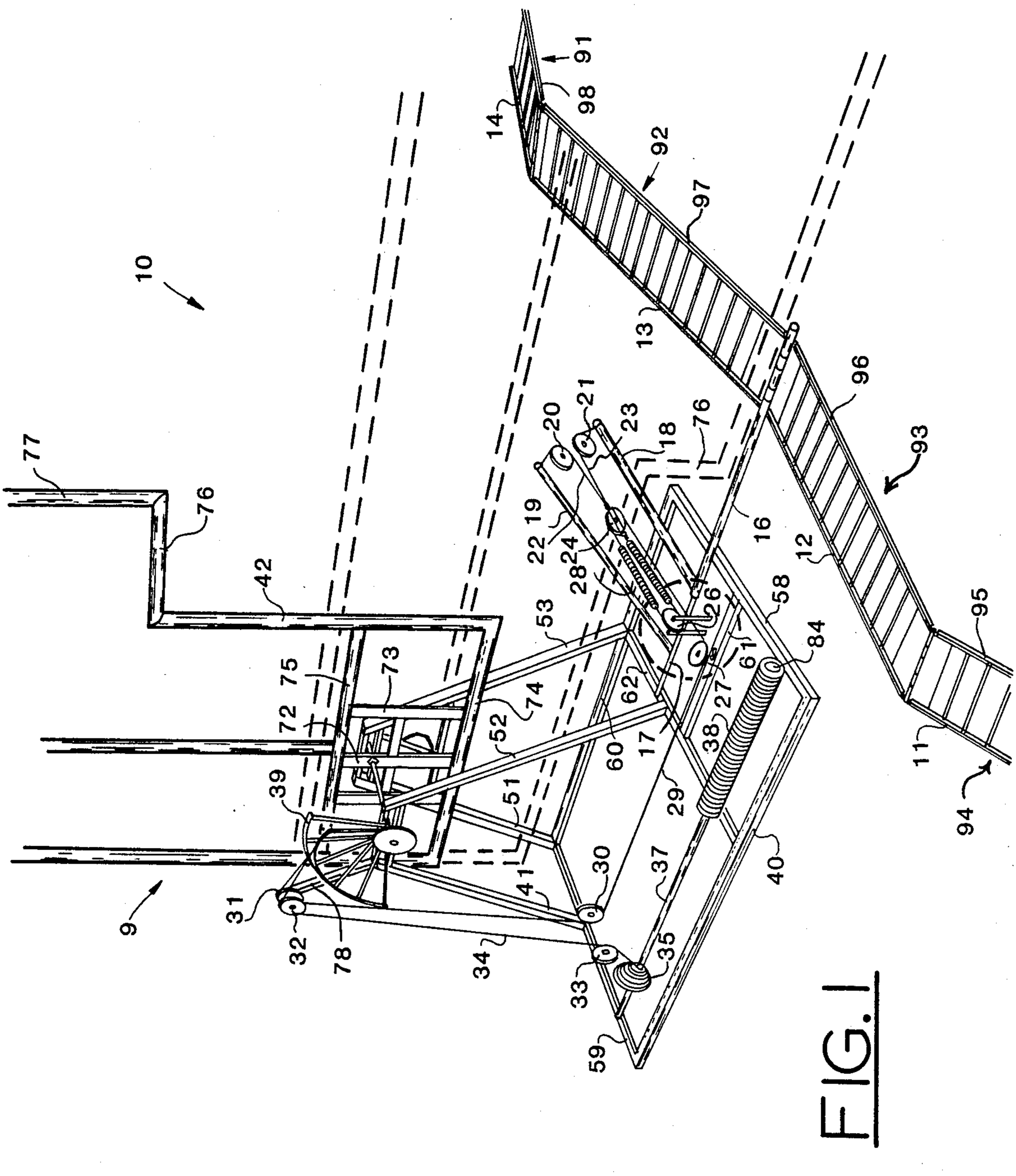

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FIG. 1

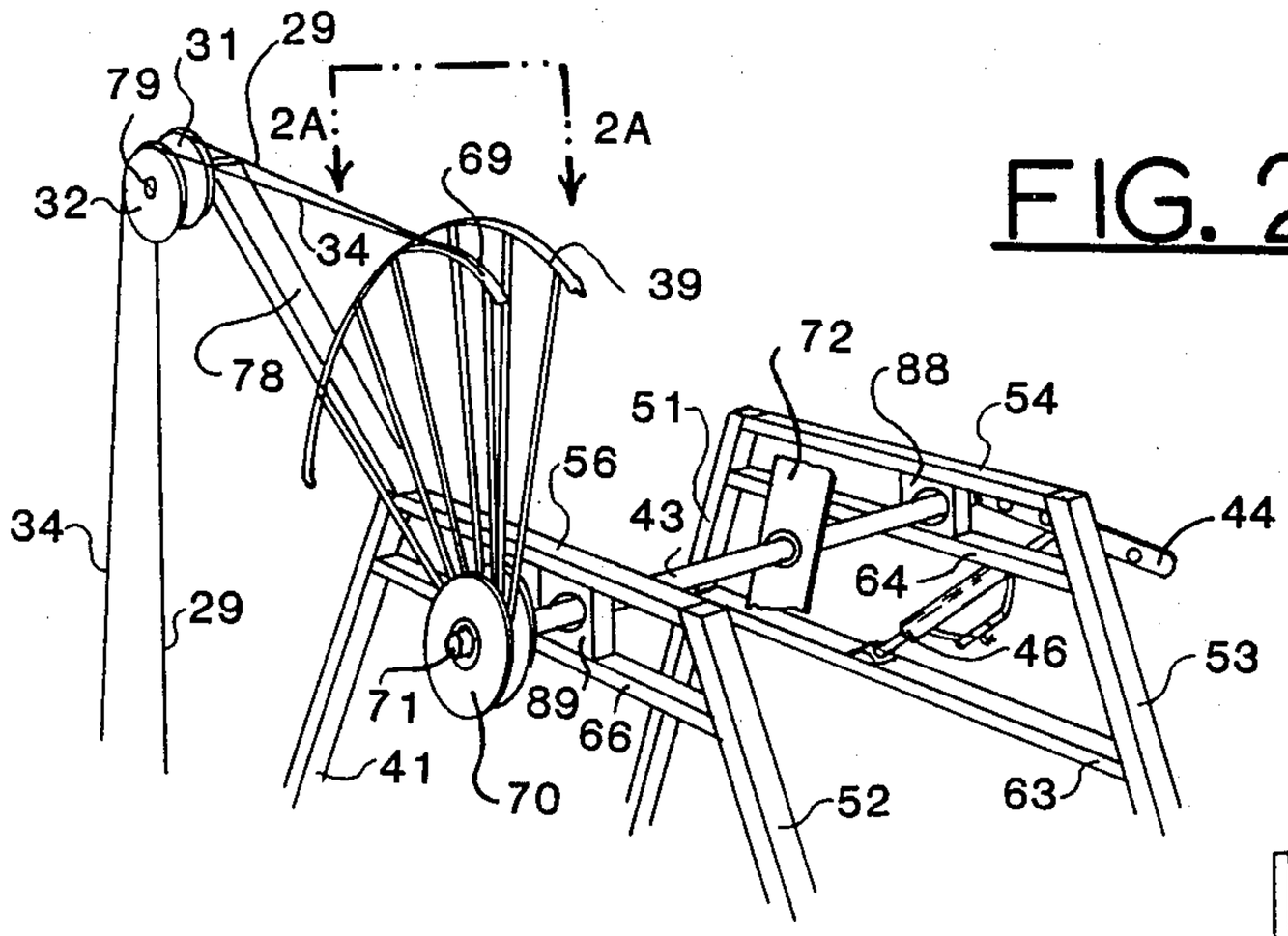

FIG. 2

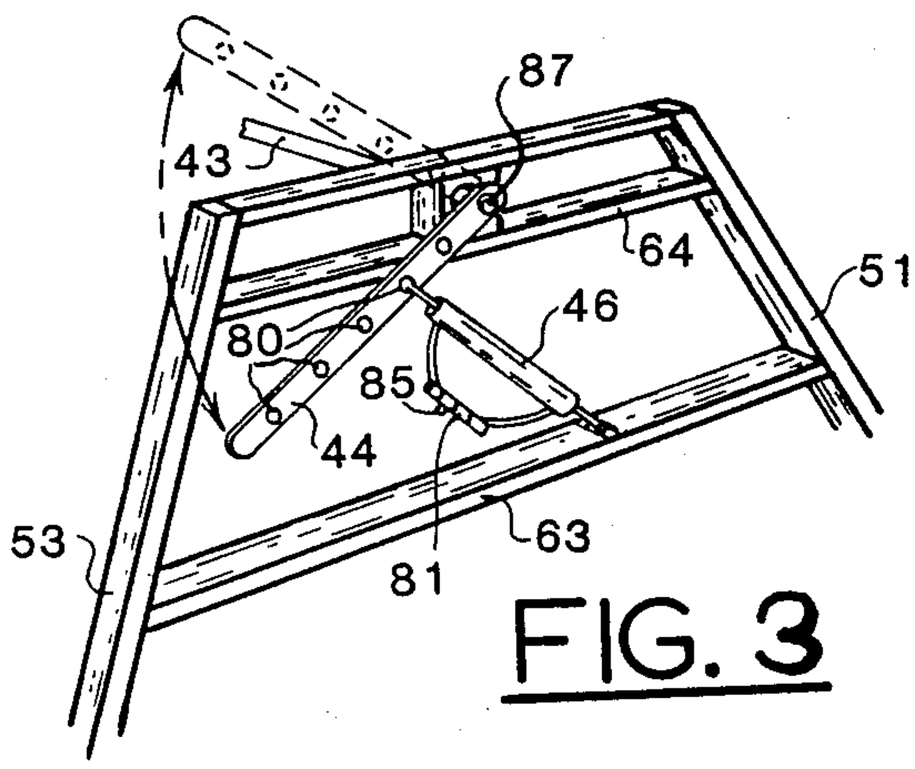

FIG. 3

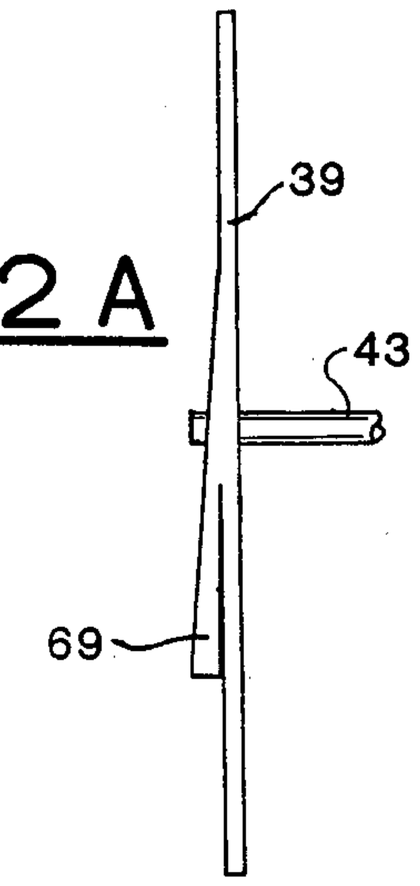

FIG. 2A

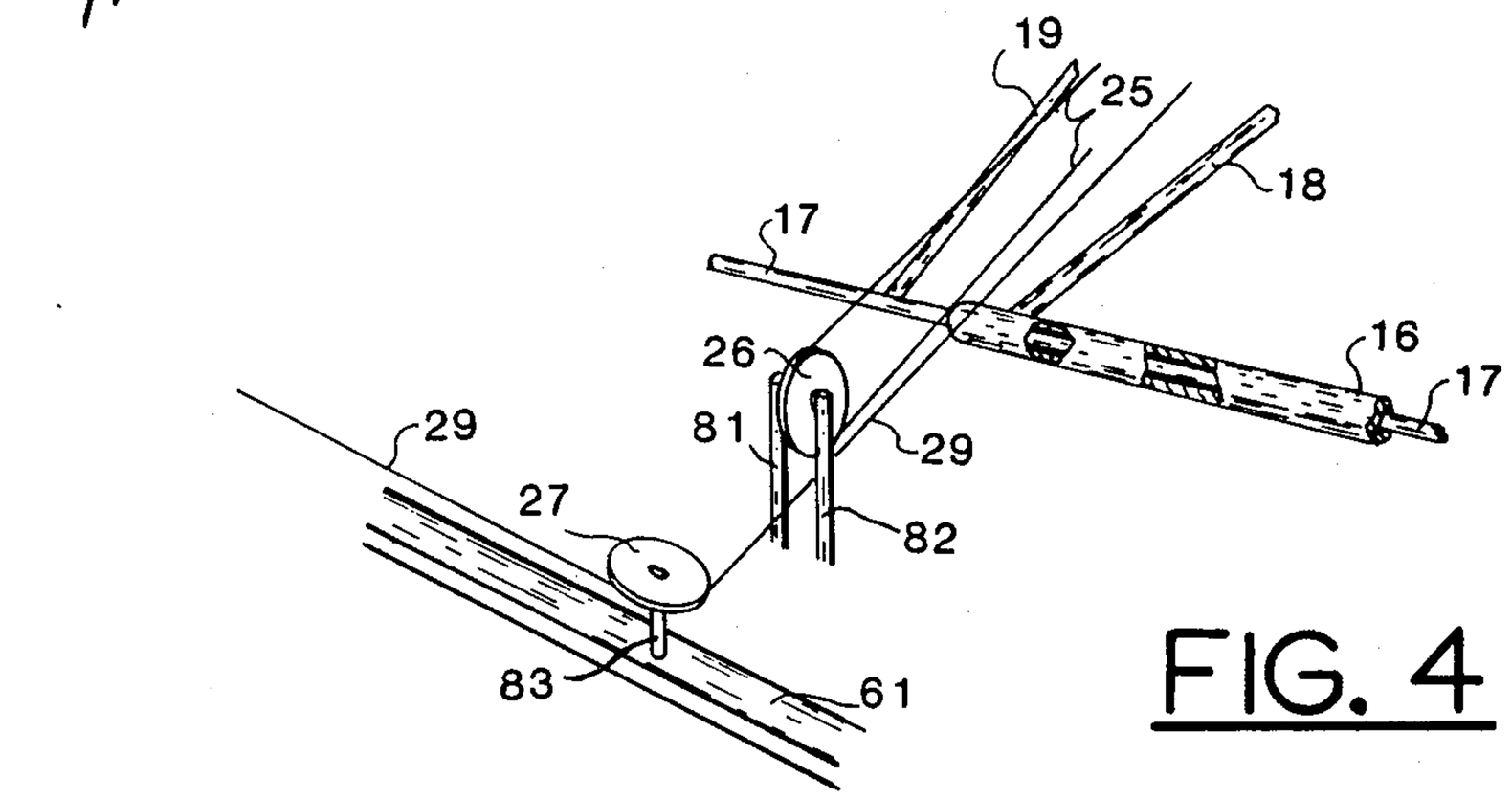

FIG. 4

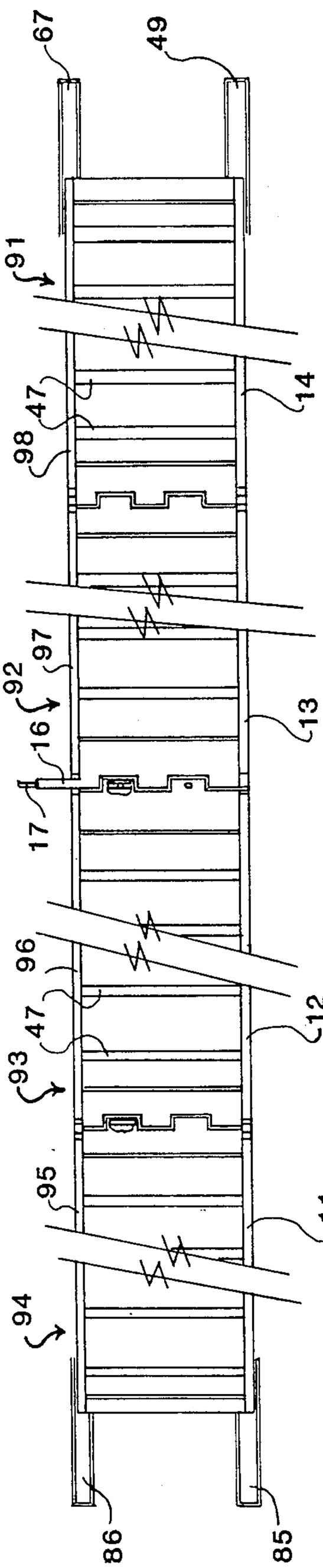

FIG. 5

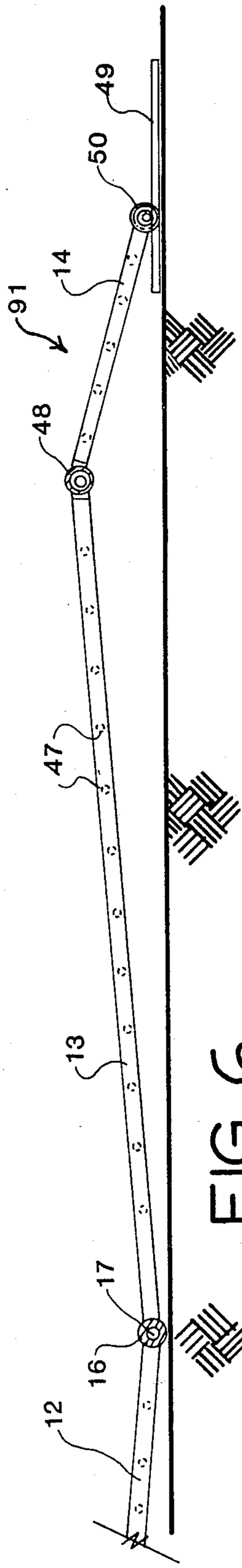

FIG. 6

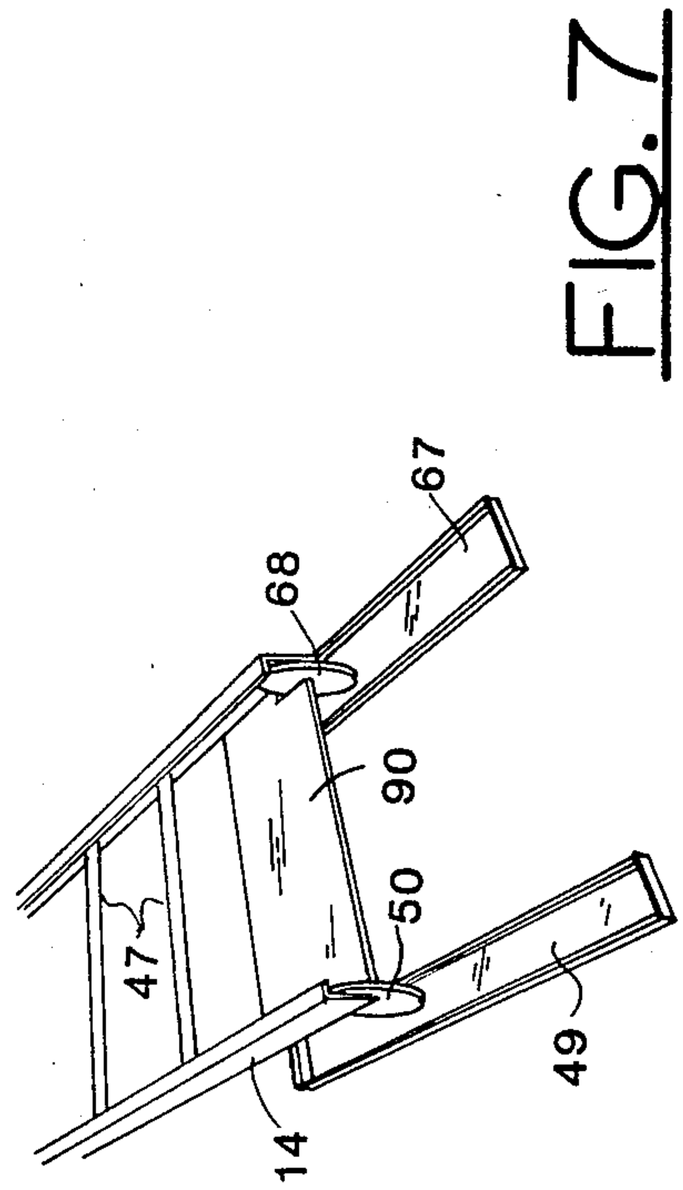

FIG. 7

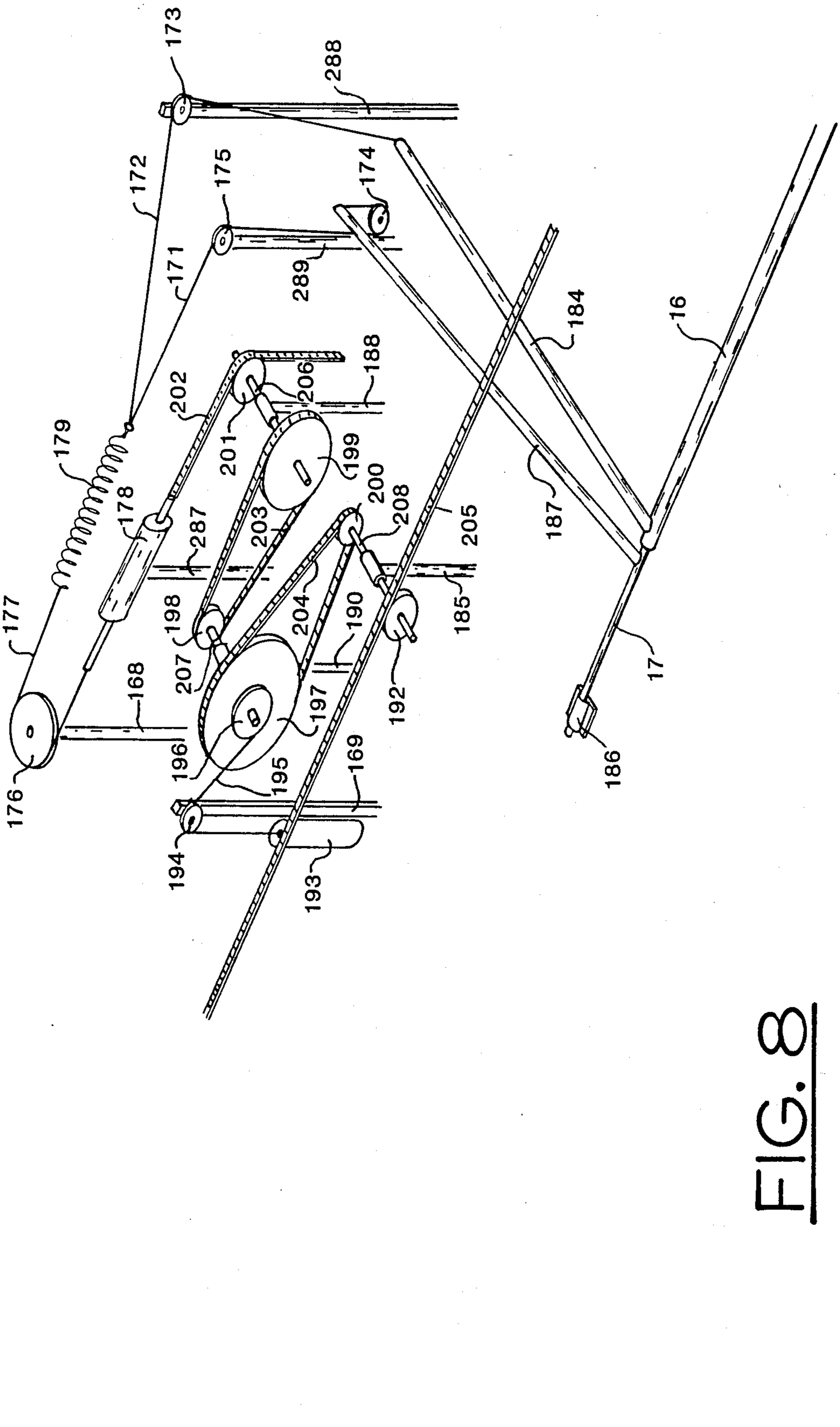
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FIG. 8

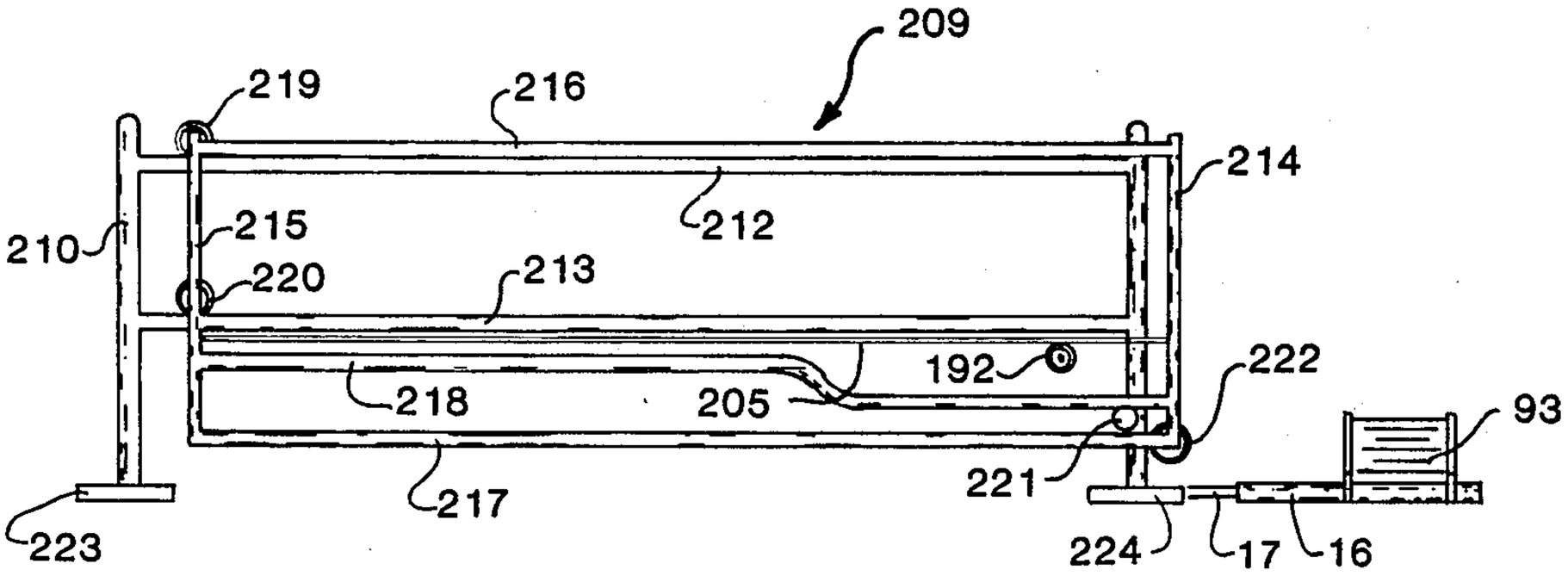
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FIG. 9

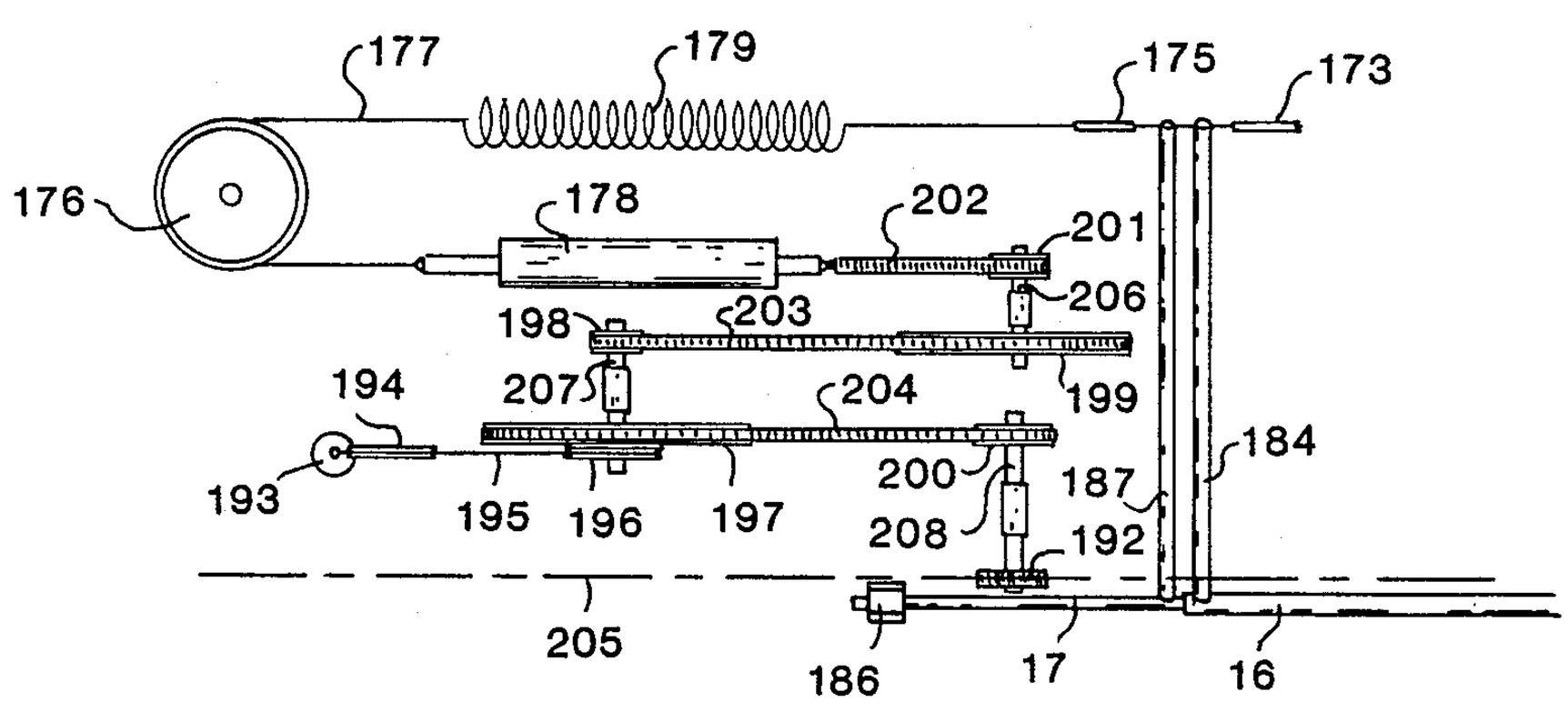
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FIG. 10

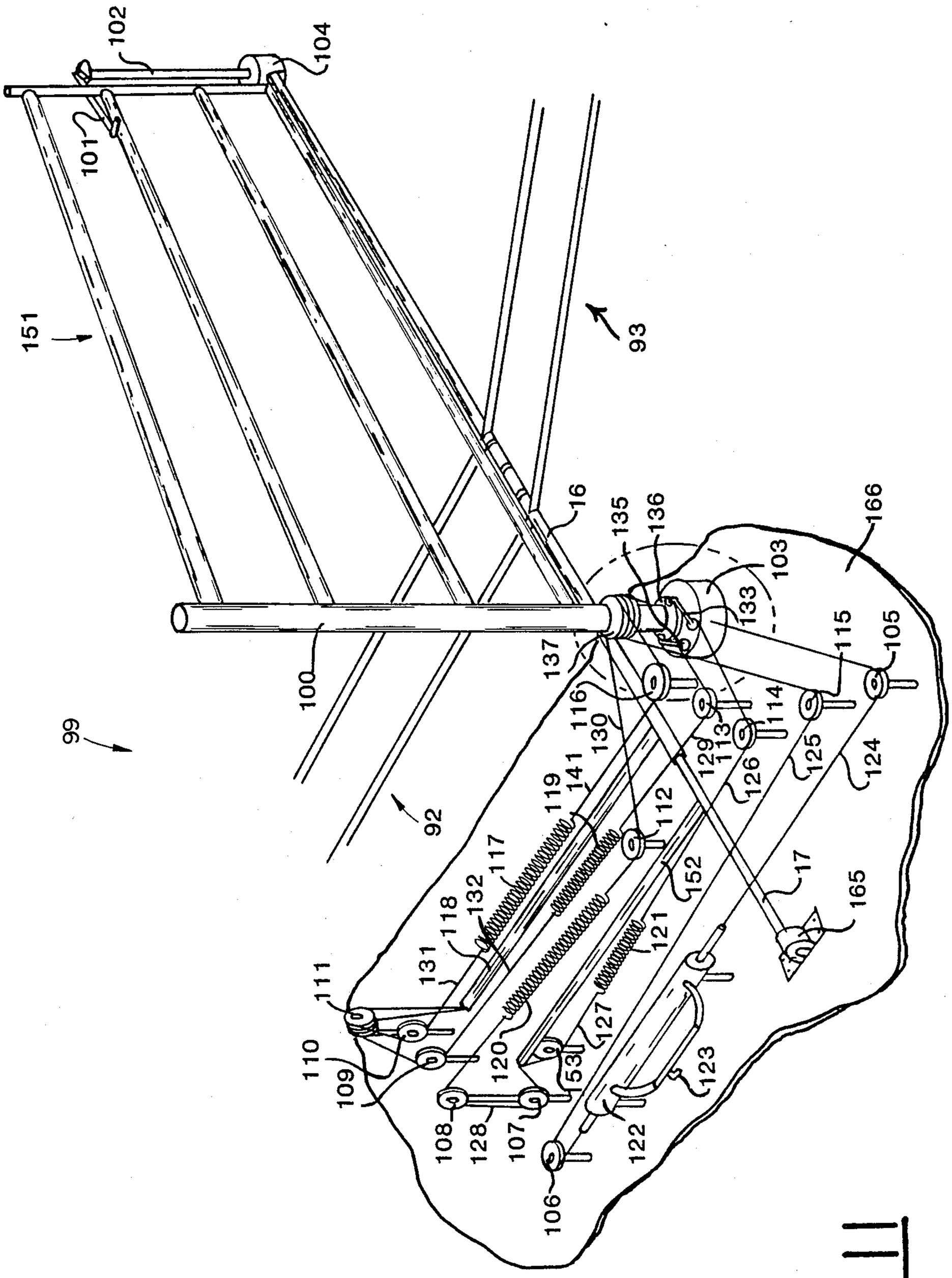
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FIG. 11

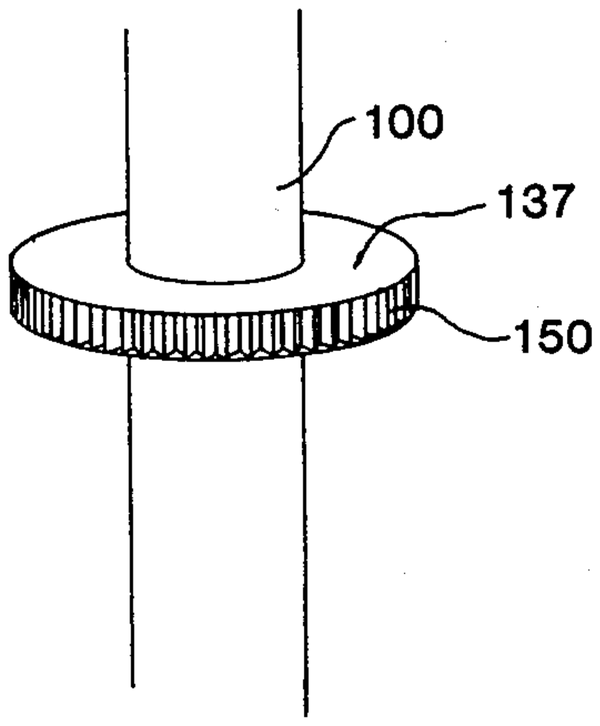

FIG.12

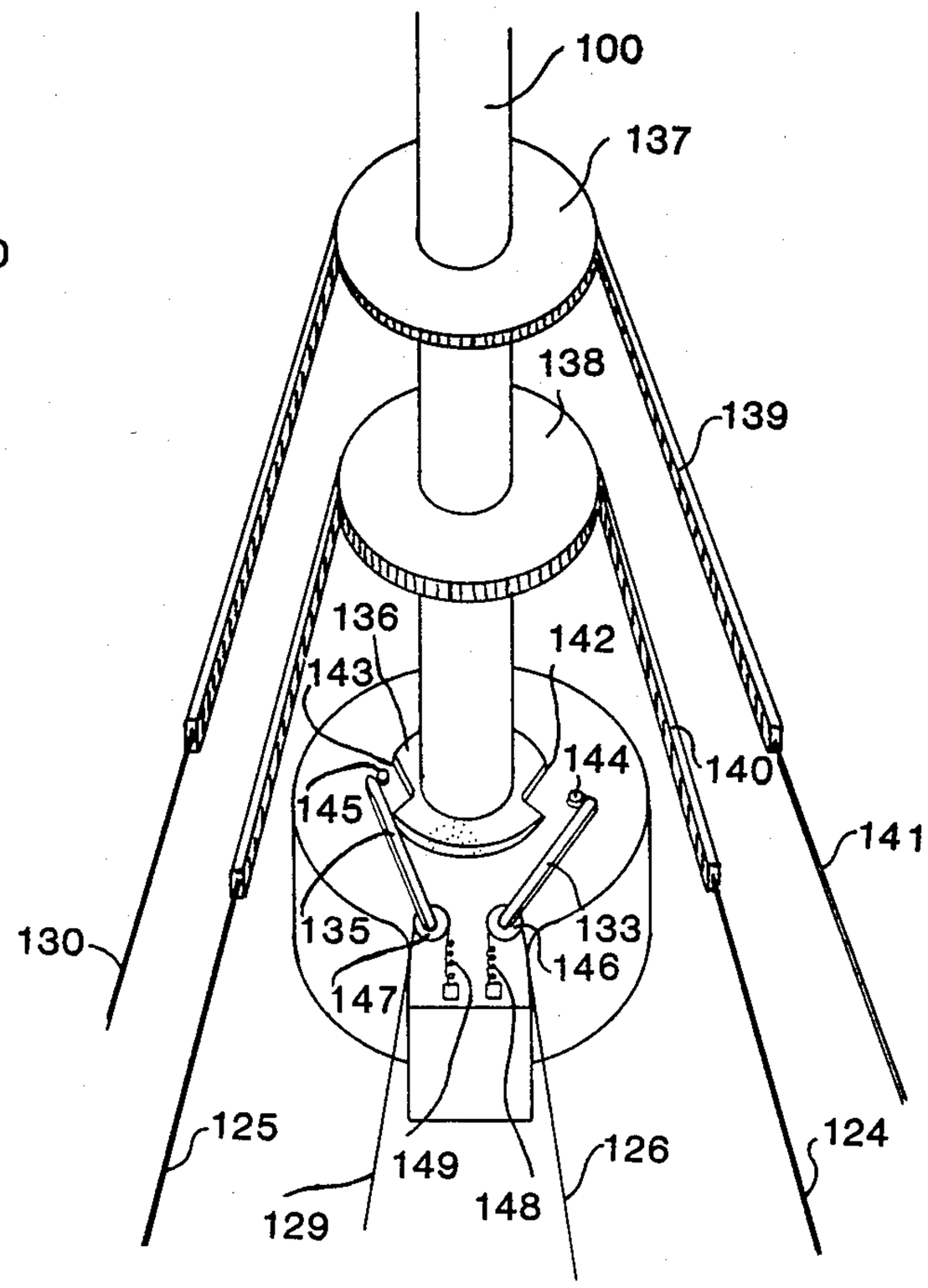

FIG.13

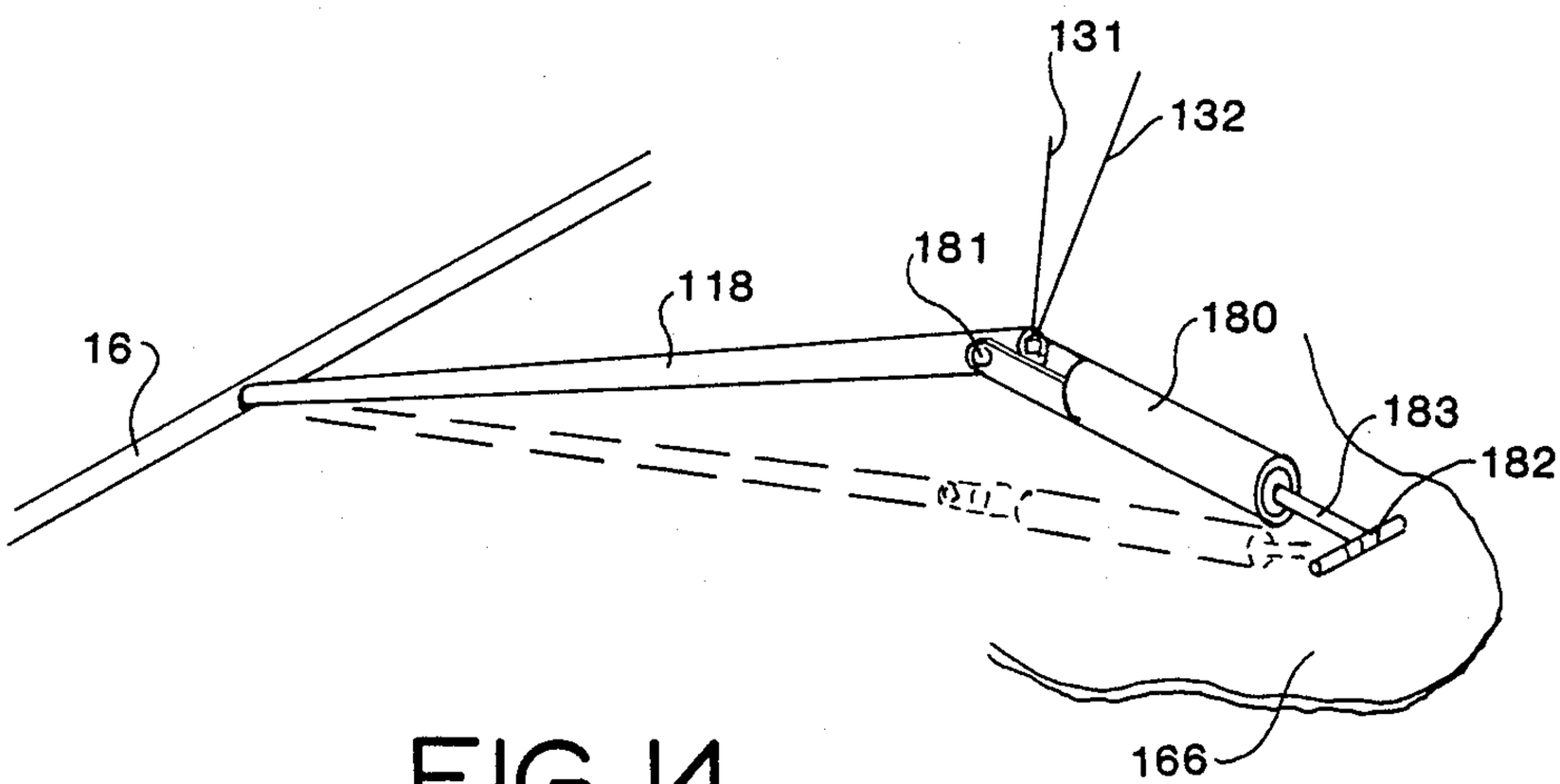

FIG. 14

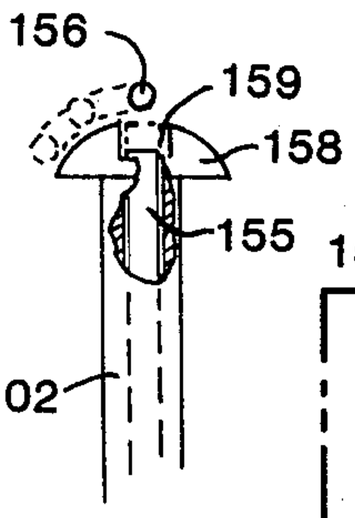

FIG.15

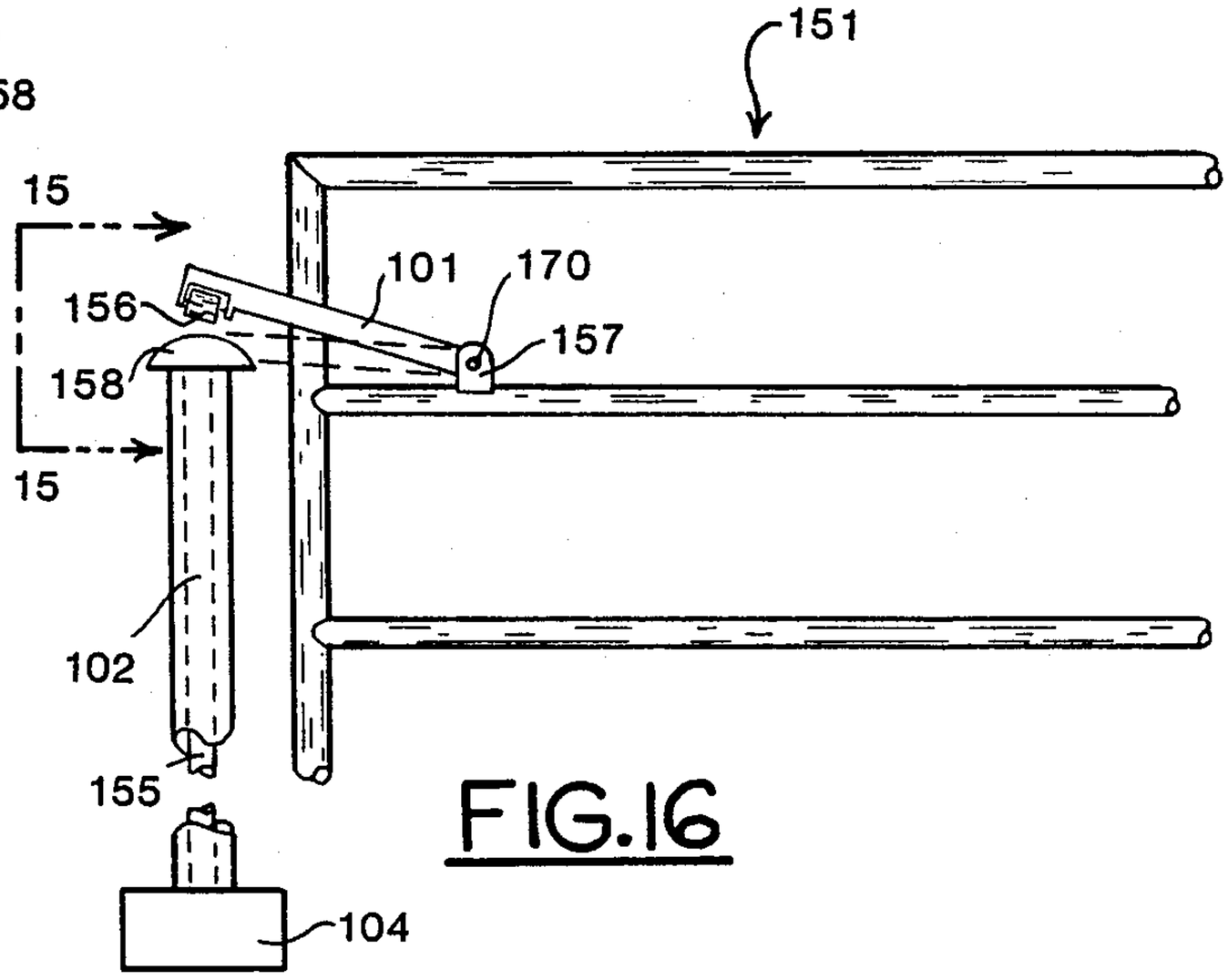

FIG.16

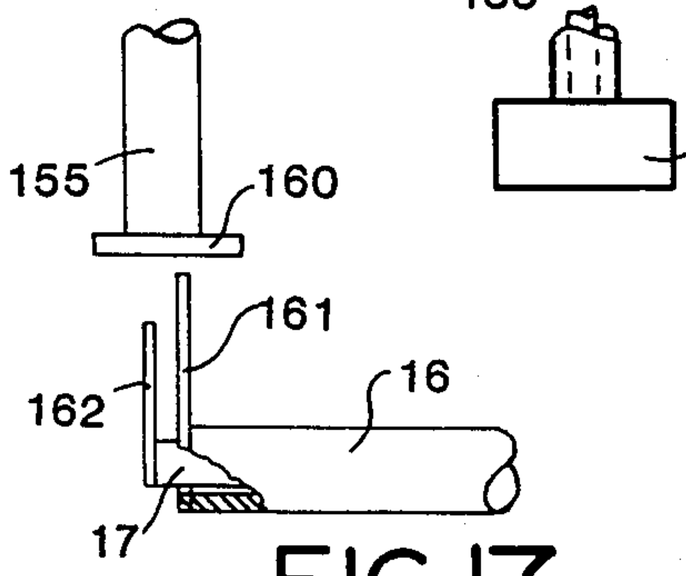

FIG.17

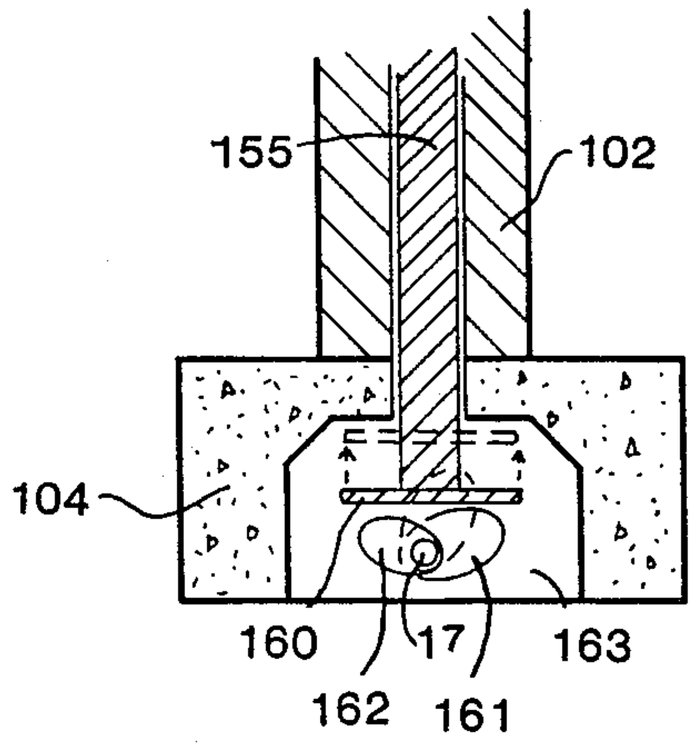

FIG.18

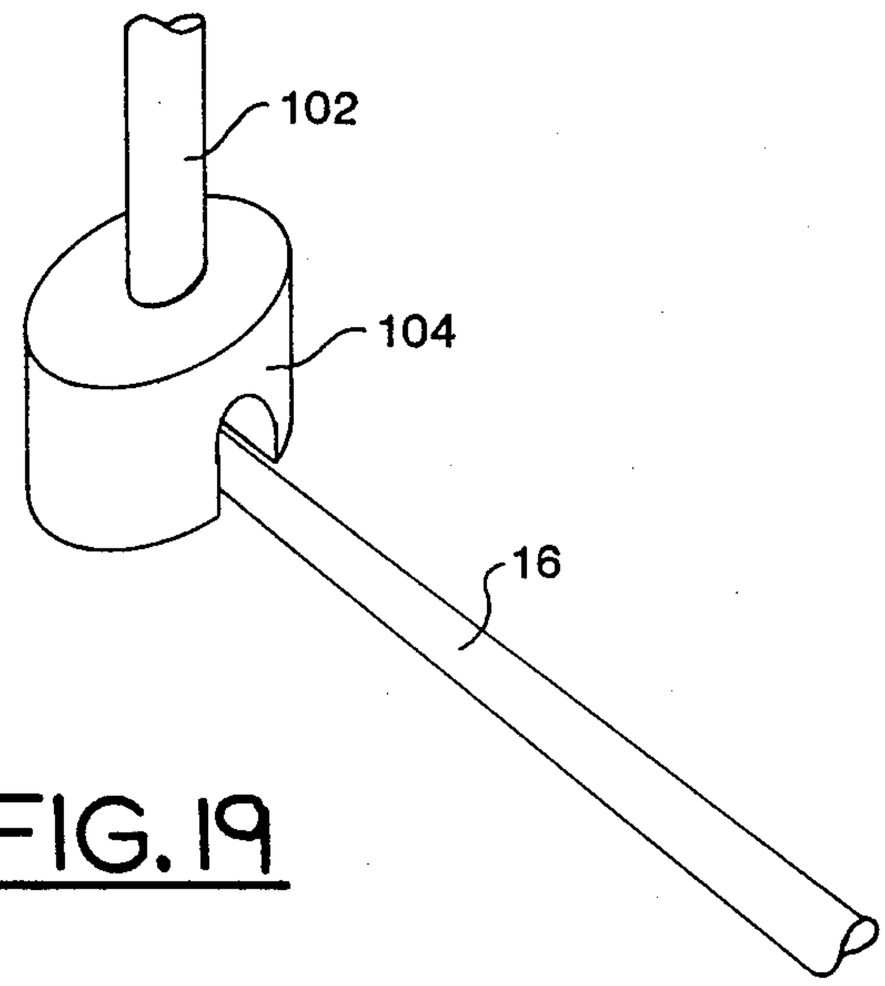

FIG.19

RAMP-OPERATED MECHANICAL GATE SYSTEMS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to the area of fences and gates; more specifically to mechanical gate systems, and particularly to mechanical gate systems which are operated automatically as a result of the presence of a motor vehicle in close proximity to the gate.

2. Description of the Prior Art

In the past, inventors have directed their efforts toward designing gates and mechanical or electrical systems for opening and closing them. These systems have been cumbersome and have failed to include features necessary to produce a gate attractive in the marketplace, inexpensive to build and relatively simple to maintain.

SUMMARY OF THE INVENTION

The present invention consists of ramp-operated, mechanically automatic gate systems which require no direct human effort for purposes of opening or closing a gate; nor do they require the use of electrical energy, the power source normally required to operate conventional automatic gate openers.

The invention includes a vertically-swinging gate, a sliding gate and a side-swinging gate.

The opening and closing of the gate is accomplished by means of the downward force of vehicle weight exerted upon a collapsible ramp which is mechanically connected to the gate system. The ramp extends outward on both sides of the gate, thereby enabling the gate to be opened automatically from either side. The gate is closed automatically by the use of springs and/or counterweights.

One of the objects of the present invention is to provide gate systems which utilize the weight of a vehicle to open a gate automatically, thereby enabling a driver to pass through the gate without leaving his vehicle to open and close it.

Another object of the present invention is to provide automatic gate systems which do not require the use of electrical energy or physical energy on the part of an individual to open and close a gate, but rather utilize the weight of a vehicle for that purpose.

Another object of the present invention is to provide unique automatic gate systems which are usable in a multitude of circumstances in that vertically-swinging gate, sliding gate and side-swinging gate embodiments are shown.

A further object of the present invention is to provide automatic gate systems which are relatively trouble-free and reliable.

A further object of the present invention is to provide automatic gate systems which automatically close the gate after a vehicle passes through it.

The foregoing objects and benefits, as well as further objects and benefits of the present invention, will be made manifest in the descriptions and claims which follow.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** of the drawings is a perspective view showing the power transfer mechanism of the vertically-swinging gate.

FIG. **2** of the drawings is a perspective view showing an expanded view of the structure shown in FIG. **1**.

FIG. **2A** is a top view of the cam wheel taken along lines **2A—2A** of FIG. **2**.

FIG. **3** is a perspective view showing more clearly the support structure which holds the vertically-swinging gate in position.

FIG. **4** is an expanded view showing part of the mechanism for transferring power from the ramp to the vertically-swinging gate.

FIGS. **5, 6** and **7** show the construction of the ramp used to supply mechanical energy to each of the gate systems.

FIG. **8** is a perspective view of the power transfer mechanism utilized in operating the sliding gate system.

FIG. **9** is a front view showing the structure of the sliding gate and its attachment to the power transfer mechanism shown in FIG. **8**.

FIG. **10** is a top view of the power transfer mechanism shown in FIG. **8**.

FIG. **11** is a perspective view of the mechanical system utilized in operating the side-swinging gate.

FIG. **12** is an expanded view of a gear shown in FIG. **13**.

FIG. **13** is a perspective view of the end post and associated parts used in operating the side-swinging gate.

FIG. **14** is an expanded view showing more clearly the lever arm shown in FIG. **11**.

FIGS. **15** and **16** show the locking mechanism used to hold the side-swinging gate in a closed position until a vehicle is driven into place upon the ramp.

FIGS. **17** and **18** show the operation of the locking mechanism used for unlocking the side-swinging gate prior to opening.

FIG. **19** shows the outside of the locking system enclosure used with the side-swinging gate.

DESCRIPTION OF THE EMBODIMENTS VERTICALLY-SWINGING GATE

In this embodiment, the invention consists of a gate structure and associated structural support and mechanisms required to swing the gate structure upward when a vehicle drives upon a ramp designed for that purpose.

FIG. **1** of the drawings shows a perspective view of the mechanical structure of the vertically-swinging gate system (**10**) and further shows connection to the ramp structure.

Power for operating the vertically-swinging gate system (**10**) is derived from a low-profile collapsible ramp structure consisting of sections **91, 92, 93** and **94**, which are pivotally attached to each other as shown. The specific construction of the ramp structure is shown in greater detail in FIGS. **5** and **6** of the drawings. When a vehicle is driven onto the ramp structure, its weight depresses the ramp structure and the energy of that movement is transferred through a series of cables, pulleys and springs to gate (**9**), swinging it upward. When the ramp structure is no longer depressed, the weight of gate (**9**) is sufficient to close it.

More specifically, when a vehicle depresses ramp sections **91** and **92**, round rod **16**, which is attached at one end to ramp section **92** and at the other end to lever arm **18**, turns, moving lever arm **18** downward. Lever arm **19** is unaffected by this movement because it is connected through round rod **17** to ramp section **93** and it moves upward, but only when ramp section **93** is

depressed. When either lever arm **18** is pulled downward by round rod **16**, or lever arm **19** is moved upward by round rod **17**, they pull respectively on cables **23** or **22**, which are attached to pulley **24** and which, as a result of that movement, extend springs **28**. Springs **28** exert tension on pulleys **24 26**, thus moving cable **29**. Cable **29** is routed around pulley **27**, pulley **30** and pulley **31** and attached to cam extension **69** of cam wheel **39**. Cable **29** pulls cam extension **69**, turning cam wheel **39** and lifting gate **9**.

Torsion spring **38**, which is rigidly attached at point **84** to base structural member **58** and attached at the other end to round rod **37**, is relaxed when gate **9** is in a vertical position as shown in this drawing. When gate **9** is in a horizontal position, torsion spring **38** is under tension, and the tension present in torsion spring **38** tends to assist the ramp in lifting gate **9**. The tension of torsion spring **38** is communicated by variable-diameter pulley **35** to cam wheel extension **69** through cable **34**, which extends over pulleys **32** and **33**. Variable-diameter pulley **35** is rigidly attached to round rod **37** and is provided so that the tension of torsion spring **38** through the lifting cycle of gate **9** can be adjusted. Round rod **37** is pivotally attached between base structural members **58** and **59**. While such is not necessarily shown specifically in the drawings, the pulleys are all pivotally attached to the structure where appropriate, unless attached between two or more cables.

The structure upon which gate **9** pivots comprises a lower base structure consisting of rods **40, 58, 59, 60, 61** and **62**, which are rigidly attached together as shown, and further comprises an A-shaped structure more specifically shown in FIG. **2** of the drawings. This A-shaped structure consists of support rods **41, 51, 52, 53, 54, 56, 63, 64** and **66**. Bearing blocks **88** and **89** are provided to support pivot rod **43** and are rigidly attached to support rods **54** and **64** and **56** and **66** respectively. Bar **72** of gate **9** is rigidly attached to pivot rod **43** as shown and, when pivot rod **43** turns as a result of the movement of cam wheel **39**, gate **9** is raised into a vertical position. Cam wheel **39** is attached at hub **70** to pivot rod **43** with nut **71**.

FIG. **2A** shows more clearly the construction of cam wheel **39** where cam wheel extension **69** joins it.

FIG. **3** is a perspective view showing the positioning of pneumatic recuperator **46**. Pneumatic recuperator **46** extends between support rod **63** and holes **80** in adjustment bar **44** and acts as a dampener. Adjustment bar **44** is rigidly attached to the end of pivot rod **43** by nut **87**. When gate **9** is raised or lowered as a result of the turning of pivot rod **43**, that movement is modified and slowed by pneumatic recuperator **46**. The speed at which gate **9** opens or closes can be adjusted by attachment of pneumatic recuperator **46** at different holes **80** in adjustment bar **44**. Pneumatic recuperator **46** is pressurized through inflation nipple **85**. The speed at which gate **9** is raised or lowered can be modified considerably by means of adjustment of the air pressure and the position of pneumatic recuperator **46** in holes **80**.

FIG. **4** of the drawings shows round rods **16** and **17**, which communicate movement between ramp sections **92** and **93** and lever arms **18** and **19**, in greater detail. Round rod **16** is hollow and round rod **17** fits through round rod **16** and turns therein.

The construction of the ramp structure is shown in greater detail in FIGS. **5, 6** and **7** of the drawings: FIG. **5** is a top view of the ramp structure, FIG. **6** is a side view and FIG. **7** is a perspective view of the end of the ramp showing how the ramp slides during use. Ramp sections **91, 92, 93** and **94** are constructed of side rails, identified here as **11, 12, 13, 14, 95, 96, 97** and **98**, with rods **47** extending therebetween. Ramp sections **91** and **92** are hinged with rod **48**, as shown in FIG. **6**. Troughs **49, 67, 85** and **86** are provided at the ends of the ramp structure and rollers **50** and **68**, which roll upon troughs **85** and **86**, are provided to facilitate smooth operation as the ramp is depressed. Flat plate **90** is provided to enable a vehicle to enter the ramp more easily. Troughs **49, 67, 85** and **86** are constructed of heavy metal and are rigidly attached to the ground.

SLIDING GATE

In this embodiment, the invention comprises a sliding gate structure **209** which slides to an open or closed position across a driveway, utilizing as a power source the ramp structure previously discussed. The power transfer system used to move the gate laterally, including the springs and pulleys, differs considerably from those used in the vertically-swinging gate and side-swinging gate systems and is therefore described in detail herein.

As shown in FIGS. **8, 9** and **10** of the drawings, when ramp **93**, shown in FIGS. **1** and **9** of the drawings, is depressed by the weight of a vehicle, round rod **17** turns, swinging lever arm **187** upward. Round rod **17** is supported by bearing **186** with respect to base **224**. As lever arm **187** swings upward, it pulls cable **171** along pulleys **174** and **175** and extends spring **179**, which pulls cable **177** along pulley **176**, thereby exerting pressure on pneumatic recuperator **178** and pulling chain **202**. Pneumatic recuperator **178** and spring **179** act together to dampen and reduce the speed at which chain **202** turns sprocket **201**. As chain **202** turns sprocket **201**, sprockets **198** and **199**, which are linked by chain **203**, are also turned. As sprocket **198** is turned, sprockets **197** and **200**, which are linked by chain **204**, are also turned. Sprockets **199** and **201** are attached to each other by axle **206**, and sprockets **196** and **198** are attached to each other by axle **207**. As sprocket **197** turns in a counter-clockwise direction, cable **195**, which is attached to counterweight **193**, winds around pulley **196**, lifting counterweight **193** and storing the energy required to close gate structure **209**. Sprocket **200** is attached to sprocket **192** by axle **208**, and as it turns counter-clockwise, it moves chain **205** laterally and thus causes gate structure **209** to slide open.

When the vehicle moves off the ramp and pressure ceases to be exerted on either ramp section **92** or **93**, counterweight **193** pulls cable **195** along pulley **194**, turning pulley **196** and sprocket **197** in a clockwise direction and thereby turning sprockets **192** and **200** in a clockwise direction and sliding gate structure **209** laterally toward ramp section **93**, closing gate structure **209** and raising the ramp structure. As gate structure **209** slides laterally to the right in the closing operation, its right edge is supported by roller **221**, which contacts formed support **218**. Formed support **218** is bent so that, when the right end of sliding gate structure **209** clears ramp section **93**, the right side of gate structure **209** lowers and is supported on the ground by roller **222**.

Gate structure **209** consists of two vertical structural members **214** and **215**, two horizontal structural members **216** and **217** and formed support **218**, and has a chain **205** stretched tightly between vertical structural members **214** and **215**. Rollers **219** and **220** are attached to vertical structural member **215** of gate structure **209**

and roll on and are supported by horizontal structural members **212** and **213**. Horizontal structural members **212** and **213** are attached to and held permanently in place by vertical base structural members **210** and **211**, which are anchored to the ground by base supports **223** and **224**.

When a vehicle approaches the driveway from the opposite direction and depresses ramp section **92** rather than ramp section **93**, rod **16** turns, swinging lever arm **184** downward and pulling cable **172** along pulley **173**, thus exerting pressure on spring **179**. The operation of the gate system from that point on in opening and closing is the same as when ramp section **93** is depressed.

Vertical supports **168**, **169**, **185**, **188**, **190**, **287**, **288** and **289** are provided to support the pulleys and sprockets of the power transfer system, and are rigidly positioned with respect to the ground.

The size of sprockets **192**, **197**, **198**, **199**, **200** and **201** determines gear ratios and hence the distance gate **209** travels as a result of ramp depression.

SIDE-SWINGING GATE

In this embodiment the invention comprises a gate structure which swings horizontally to an open or closed position, utilizing as a power source the same ramp structure utilized in both the vertically-swinging gate and the sliding gate. However, the power transfer system, including the springs and pulleys, is considerably different and is therefore set out in specific detail herein.

FIG. **11** is a perspective view of a side-swinging gate **99**. When ramp section **93** is depressed by the weight of a vehicle, rod **17** turns, swinging lever arm **152** upward. Round rod **17** is supported by bearing **165**. When lever arm **152** swings upward, it pulls cables **127** and **128**, extending spring **121** and pulling cable **126**. Cable **126** extends around pulley **114** and disengages lock lever **133** from locking disk **136**, thereby enabling gate structure **151** to pivot and swing outward toward ramp section **92**. At the same time, lever arm **152** pulls cable **128** along pulleys **107** and **108**, extending spring **120** and pulling cable **130** along pulley **112**. Cable **130** is linked to sprocket **137** by chain **139**, and as it turns sprocket **137**, gate structure **151** opens away from the vehicle and toward ramp section **92**. Movement of gate structure **151** as it opens, which would otherwise be relatively rapid, is slowed by spring **120** and pneumatic recuperator **122**, which acts as a dampener. Pneumatic recuperator **122** is attached to cables **124** and **125**, which extend around pulleys **105**, **106** and **115** and attach to chain **140**, which engages sprocket **138**. As a result of the tendency of pneumatic recuperator **122** to slow down the movement of gate structure **151**, the energy realized from the collapsing of ramp section **93** is temporarily stored in spring **120**.

When a vehicle approaches from the opposite direction and ramp section **92** is depressed, round rod **16** turns, swinging lever arm **118** downward and pulling cables **131** and **132**, which extend spring **119** and pull cable **129**. Cable **129** extends around pulley **113** and disengages lock lever **135** from locking disk **136**, thereby enabling gate structure **151** to open toward ramp section **93**. At the same time, lever arm **118** pulls cable **131** along pulleys **110** and **111**, extending spring **117** and pulling cable **141** along pulley **116**. Cable **141** is linked to sprocket **137** by chain **139**, and as it turns sprocket **137**, gate structure **151** opens away from the vehicle and toward ramp section **93**. Pneumatic recuperator **122** reacts in the manner previously discussed regardless of the direction in which gate structure **151** opens. When ramp sections **92** and **93** are no longer depressed, gate structure **151** is closed by springs **117** or **120**, depending on the direction in which gate structure **151** opened. The pulleys as shown are pivotally attached by pivot pins to base **166**, which is constructed generally of concrete or some other appropriate material. Other pulleys are structurally mounted as shown. A latch arm **101**, latch mechanism housing **102** and latch mechanism base **104** are shown at the opposite end of gate structure **151** from the mechanism upon which gate structure **151** pivots. The latch mechanism is shown more clearly in FIGS. **15** through **19**.

FIGS. **12** and **13** of the drawings show round rod **100**, upon which gate structure **151** is mounted, in greater detail. Sprockets **137** and **138** are rigidly attached to round rod **100** and are engaged by chains **139** and **140**, to which cables **124**, **125**, **130** and **141** are attached. Locking disk **136** is cut out at **142** and **143** such that, when lock lever **133** is released, gate structure **151** will open in one direction only, and when lock lever **135** is released, gate structure **151** will open in the opposite direction only. Lock levers **133** and **135** are normally held in a locked position by springs **148** and **149**. Cables **126** and **129** are used to activate lock levers **133** and **135**.

FIG. **14** shows the construction of lever arm **118**. Pneumatic recuperator **180**, which is pivotally attached to the end of lever arm **118** by pivotal attachment means **181** and to base **166** by pivotal attachment means **182**, guides lever arm **118** and acts as a dampener. Lever arm **152** is constructed in a similar manner.

FIGS. **15** through **19** show the latch mechanism used to hold gate structure **151** in a closed and locked position when not in use. Cam **162** is rigidly attached to the end of round rod **17**, and cam **161** is attached to the end of round rod **16**. When ramp section **92** is collapsed, turning round rod **16**, cam **161** turns upward, pushing flat plate **160** upward and moving push rod **155** upward. When ramp section **93** is collapsed, turning round rod **17**, cam **162** turns, pushing flat plate **160** upward and moving push rod **155** upward. When push rod **155** is moved upward, it forces latch arm **101** out of slot **159** and unlocks gate structure **151**. Push rod **155** extends through hollow latch mechanism housing **102**, and dome **158** is placed at the top of latch mechanism housing **102**. Dome **158** has a slot **159** designed to accept roller **156** of latch arm **101**. Roller **156** slides over dome **158** and into slot **159** without damaging latch arm **101**. Latch arm **101** is pivotally attached by pivot pin **170** to gate structure **151** at point **157**. Cams **161** and **162**, as well as plate **160**, are located inside of cavity **163** in latch mechanism base **104**. Latch mechanism base **104** is constructed generally of concrete or some other appropriate material. FIG. **19** shows generally the outward appearance and construction of latch mechanism base **104** and associated components.

The ramp-operated mechanical gate systems can also include remote-controlled, radio-activated locking and unlocking systems to provide added security and, which not specifically disclosed herein, such systems are contemplated for use with the present invention.

The foregoing descriptions of embodiments have disclosed specific construction of embodiments at present. However, because improvements and modifications will become readily apparent to those skilled in the art of design and construction of gates and the like, it is

applicant's intent not to be limited by any of the foregoing descriptions, but only by the claims which follow.

I claim:

1. A ramp-operated mechanical gate system, comprising:

a gate support structure;

a gate structure pivotally attached to said gate support structure;

a collapsible ramp of sufficient size and strength to withstand the weight of a motor vehicle and offset from said gate support structure;

a first rod rigidly attached to and extending substantially perpendicularly from said collapsible ramp toward said gate support structure which turns when said collapsible ramp is depressed;

a lever arm attached to and extending substantially perpendicularly from said rod, and

power transfer means connected between said lever arm and said gate structure such that said gate structure opens when said collapsible ramp is depressed, and having at least one spring.

2. The invention of claim 1, including dampening means to slow movement and reduce vibration of said gate structure.

3. The invention of claim 2, wherein:

said gate support structure consists of a substantially vertical gate post, and

said gate structure is pivotally attached to said substantially vertical gate post on a substantially vertical axis such that said gate structure pivots along a substantially horizontal plane.

4. The invention of claim 3, including locking means for holding said gate structure closed until said collapsible ramp is depressed, consisting of:

a second rod rigidly attached to and extending substantially perpendicularly from said collapsible ramp away from said gate support structure which turns when said collapsible ramp is depressed;

a cam attached to said second rod, and

latch means activated by movement of said cam.

5. The invention of claim 2, wherein:

said gate support structure includes substantially horizontal pivot means which turn when said first rod turns, and

said gate structure is rigidly attached to said substantially horizontal pivot means so that said gate structure swings upward or downward when said substantially horizontal pivot means turn.

6. A ramp-operated mechanical gate system, comprising:

a gate support structure;

a substantially rectangular gate structure slidably attached to said gate support structure;

a collapsible ramp of sufficient size and strength to withstand the weight of a motor vehicle and offset from said gate support structure;

a rod rigidly attached to and extending substantially perpendicularly from said collapsible ramp toward said gate support structure which turns when said collapsible ramp is depressed;

a lever arm attached to and extending substantially perpendicularly from said rod;

power transfer means connected between said lever arm and said substantially rectangular gate structure such that said substantially rectangular gate structure slides open when said collapsible ramp is depressed and having at least one spring, and

a counterweight attached to said power transfer means whereby said substantially rectangular gate structure slides closed when said collapsible ramp is released.

7. The invention of claim 6, including dampening means to slow movement and reduce vibration of said substantially rectangular gate structure.

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